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ABSTRACT

This bibliography lists 1,196 articles dealing with the metric system. Entries are arranged alphabetically by author and include the title, publication information, and date of publication. A subject index is provided. (SB)

BIBLIOGRAPHY
OF THE
Metric System

compiled by

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FOREWORD

This listing of metric system literature sources is the result of the compilers' inability to find a comprehensive metric system bibliography while researching material for an article on the subject. It will be noted that some of the references give more complete source identification than others. This resulted because the data were obtained from a wide variety of sources (library files, reader-indexes, collections maintained by organizations and individuals, footnoted items, etc.), which had been set up to fulfill requirements of the specific user. This bibliography is divided into two parts: the alphabetical listing which identifies each entry by number, and a subject index which codes each entry number to major subjects covered in that entry.

The authors wish to express their appreciation to all those who aided in the compilation of this bibliography. We are particularly indebted to Mr. Jon Seremak and Mr. Ted Cebula of the Hughes Aircraft Company Technical Document Center, who supplied reference material; to Mr. Fred Helgren, President, and Mr. Louis Sokol, Secretary, of the Metric Association, who permitted the use of the Association's and their own files; to Mrs. Marlene Post, Mrs. Jane Weston, and Miss Ruth Perl, who provided valuable editorial and typing assistance; and to Mr. Rick Hinkel, who handled cover design and artwork.

In the interest of future updating of this bibliography, readers are invited to submit appropriate reference material, directing it to the authors, in care of the Metric Association.

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PREFACE

". . . . Now the British are making the changeover (to metric), leaving us with the choice of accepting the worldwide language of measurement or of indulging in the luxury of a measurement system which will soon be peculiar to us alone . . . "

Lewis L. Strauss, former
Acting U. S. Secretary of Commerce

Of the two major systems of weights and measures used in the world today, the United States of America uses the oldest one, which is based upon the inch and the pound. The other system, presently used by over 90 percent of the world's population, is the metric system, with the meter and kilogram as its base.

The metric system originated nearly 200 years ago, primarily to keep the people of France from being cheated by traders. There were so many different types of measuring systems at that time that unscrupulous merchants bought long measure upcountry and sold short measure in towns, reaping huge profits, while swindling the farmers and artisans as well as the people who bought these workers' goods.

Value of the standardized metric measurements used by the French soon became so apparent to residents in adjoining countries, that these countries gradually adopted metric weights and measures. A steady progression of metric usage, in the majority of the world's countries, followed; and now the internationally-understood language of measurements based on the metric system is called the International System of Units, or SI.

Early in U. S. history, efforts were made to abandon the complicated inch-pound system in favor of the metric system. These efforts led to enactment of legislation by Congress, in 1866, that made the metric system the only legal system of weights and measures in the United States. The law, however, did not state that use of metric measurements is compulsory.

Since that time, consistent but unsuccessful attempts have been made to pass a law that makes the metric system the only legal system in the United States. In 1902, a bill for conversion to metric measurements in America seemed assured of passage; but, due to a crowded agenda, its sponsor sanctioned deferral of the vote until after Congress reconvened. This allowed enough opposition to build up to cause the sponsor's withdrawal of the bill from the Congressional hopper.

Starting in 1960, an almost-annual attempt has been made to get Congress to approve a comprehensive study on advantages and disadvantages of U. S. adoption of the SI. In general, these bills have met with positive results in the Senate, but have been held up by the Rules Committee in the House of Representatives.

Nevertheless, the Unites States has drifted toward metrics, and now uses a mixture of inch-pound/metric measurements, with the inch-pound system predominating. The SI has become the language of science in America. A number of groups (optical, pharmaceutical, chemical, etc.) have converted to the SI within their own industries. These groups report substantial advantages plus lowered costs from the changeover. Many Americans are not aware that they are using metric measurements when they order 35mm film, mention electrical volts, count calories, or state how many grams of vitamins they are taking.

In the meantime, the pro and con debates wax, but never wane. An endless stream of literature is generated, as evidenced in this bibliography that represents barely a fraction (i. e., a millimeter) of available metric data. Many notable scientists and engineers strongly advocate conversion to SI; and a number of foresighted Congressmen, with a genuine concern for the economic future of this nation, are continuing to work toward adoption of the much-simpler SI, which is perhaps the closest thing the world has to an international language.

Also promoting the use of the SI in American schools, commerce, and industry is the Metric Association, a national nonprofit organization. It publishes the quarterly, METRIC ASSOCIATION NEWSLETTER, with information on metric progress in the United States and throughout the world.

Metric System

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SUBJECT INDEX

(Numbers given after subject titles refer to number under which entry is listed)

METRIC UNITS FOR COMMON USE

The Metric System of weights and measures includes units for measuring physical quantities which every one of us use every day. The three main units; meter, liter, and gram, can be changed to more convenient sized units for specific purposes by means of several well known prefixes. Milli means 1/1000, centi means 1/100, deci means 1/10, and kilo means 1000. One merely learns the main units and the value of the most commonly used prefixes. The symbols for metric units are the same for single and plural amounts and are not followed by a period. Rates are usually shown by use of the slash as in m/s.

Quantity	Unit	Symbol	Relationship of Units
	millimeter	mm	1 mm = 0.001 m
	centimeter	cm	1 cm = 10 mm
Length	decimeter	dm	1 dm = 10 cm
	meter	m	1 m = 100 cm
	kilometer	km	1 km = 1000 m
	square centimeter	cm^2	1 cm^2 = 100 mm^2
	square decimeter	dm^2	1 dm^2 = 100 cm^2
	square meter	m^2	1 m^2 = 100 dm^2
Area	are	a	1 a = 100 m^2
	hectare	ha	1 ha = 100 a
	square kilometer	km^2	1 km^2 = 100 ha
	cubic centimeter	cm^3	1 cm^3 = 0.001 l
	milliliter	ml	1 ml = 0.001 l
Volume	cubic decimeter	dm^3	1 dm^3 = 1000 ml
	liter	l	1 l = 1000 ml
	cubic meter	m^3	1 m^3 = 1000 l
	milligram	mg	1 mg = 0.001 g
Mass*	gram	g	1 g = 1000 mg
	kilogram	kg	1 kg = 1000 g
	metric ton	t	1 t = 1000 kg

The underlined units in the above table are basic or derived units of the International System of Units (SI) which is described on page 9.

The Metric System simply and logically coordinates the measurements of length, area, volume, and mass into one decimalized system. United States currency, with its unexcelled convenience, was the first large scale national use of a decimal system. The ratio between the units of the series — dollars, dimes, cents, and mills — is ten. Additions and other numerical operations are simple. Except by adjustment of the decimal point, the Metric System requires no conversion from unit to unit as in the U.S. Customary System, as for example between inches and feet or ounces and pounds.

*Mass is the quantity of matter; whereas weight is a force, Earth's attraction for a given mass. Generally, the term mass is meant when we use weight.

In the Metric System there is one series of units for length, one for area, one for volume or capacity, and one for mass.

LENGTH — The common metric units of length are the millimeter (mm) for small dimensions, the centimeter (cm) for daily practical use, the meter (m) for expressing dimensions of larger objects and short distances and the kilometer (km) for longer distances. The centimeter is about four-tenths of an inch. The meter is about forty inches and the kilometer about six-tenths of a mile. When drawing to metric scale, engineering and product dimensions are in millimeters, while architectural drawings can be in millimeters or centimeters. On land surveys the unit is the meter, whereas for maps the kilometer is used.

AREA — Small areas are usually measured in square centimeters (cm^2). In building and construction the square meter (m^2) is used and is about 20 per cent larger than a square yard. The hectare (ha) is used for land surveys and is equal to 2.47 acres.

VOLUME — For volume the most convenient unit is the cubic decimeter (dm^3) which is commonly referred to as the liter (l)*. The liter is slightly larger than the U.S. liquid quart but smaller than the U.S. dry quart and the British Imperial quart. The preferred unit for dispensing drugs and for scientific work is the cubic centimeter (cm^3) or milliliter (ml) as it is also called. For measuring amounts of concrete and excavations the cubic meter (m^3) is used and is about 30 per cent larger than the cubic yard.

MASS — In pharmaceutical and scientific work the gram (g) is the most convenient unit. There are slightly less than 30 grams in one avoirdupois ounce. For most other uses the kilogram (kg) is convenient and equals 2.2 pounds. The metric ton (t), 1000 kg, is used for farm commodities, minerals, and large shipments. It is convenient that a liter of pure water at standard temperature and pressure contains a mass of almost one kilogram (discrepancy less than one part in 10 000). This relationship makes it easy to determine the mass of any known volume of water, or of any other liquid if its specific gravity is known.

TEMPERATURE — All countries using the Metric System of weights and measures also use the Celsius (°C) scale (formerly called centigrade) for ordinary measurement of temperature. On the Celsius scale pure water at standard atmospheric pressure freezes at 0° and boils at 100°. Normal human body temperature is 37°, while a comfortable room temperature is about 23°. The preferred temperature scale for engineering and physics is the kelvin (K) which has the same units as the Celsius and where the freezing point of pure water is 273.15 K.

*In October 1964 the 12th General Conference on Weights and Measures changed the definition of the liter to equal a cubic decimeter. Formerly the liter was the volume of one kilogram of pure water at 4°C, which made it slightly larger than a cubic decimeter.

(The above data is an excerpt from the 8th edition (1968) of "Metric Units of Measure," published by the Metric Association.)

INTERNATIONAL SYSTEM OF UNITS (SI)

Quantity	Unit	Symbol
	Basic Units	
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Luminous intensity	candela	cd
	Supplementary units	
Plane angle	radian	rad
Solid angle	steradian	sr
	Derived units	
Area	square meter	m^2
Volume	cubic meter	m^3
Frequency	hertz	Hz (s^{-1})
Density	kilogram per cubic meter	kg/m^3
Velocity	meter per second	m/s
Angular velocity	radian per second	rad/s
Acceleration	meter per second squared	m/s^2
Angular acceleration	radian per sec. squared	rad/s^2
Force	newton	N ($kg \cdot m/s^2$)
Pressure	newton per square meter	N/m^2
Kinematic viscosity	square meter per second	m^2/s
Dynamic viscosity	newton-second per square meter	$N \cdot s/m^2$
Work, energy, quantity of heat	joule	J ($N \cdot m$)
Power	watt	W (J/s)
Electric charge	coulomb	C ($A \cdot s$)
Voltage, potential difference, electromotive force	volt	V (W/A)
Electric field strength	volt per meter	V/m
Electric resistance	ohm	Ω (V/A)
Electric capacitance	farad	F ($A \cdot s/V$)
Magnetic flux	weber	Wb ($V \cdot s$)
Inductance	henry	H ($V \cdot s/A$)
Magnetic flux density	tesla	T (Wb/m^2)
Magnetic field strength	ampere per meter	A/m
Magnetomotive force	ampere	A
Flux of light	lumen	lm ($cd \cdot sr$)
Luminance	candela per square meter	cd/m^2
Illumination	lux	lx (lm/m^2)

Metric decimal prefixes

Multiplication Factors	Prefix	Symbol
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^9	giga	G
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto	h
10 = 10^1	deka	da
1	(Units)	
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

ADVANCE OF METRIC USAGE IN THE WORLD